Art. XIX.—*Teratological Notes; Part 1.*

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(With Plate XXIX.).

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By means of this and other papers to follow, it is intended to place on record occurrences of interest to specialists in vegetable teratology which have come under my notice during the past few years. The present paper includes references to seedlings only, leaving to future parts notes on heterotaxy and morphological deviations in foliage, etc., of older plants, particularly with regard to some of our indigenous flora.

Abnormal Seedlings.[1]

Cotyledonary leaves, regarded as of diagnostic value by Ray at the end of the 17th century, but not used by him in the genesis of the natural system of classification, were placed in commission, as it were, by Jussieu, in limiting the primary divisions of the angiosperms. Since then the cotyledons have been recognised with due regard for their importance in association with other characters, but occasionally—and in some cases frequently—polycotylous forms appear among normal contemporaries of the same species of dicotyledons; and other aberrations are not uncommon—at least in cultivated plants.

The most frequent abnormality noted by me was the polymerous whorl of cotyledons; the next, polyphylly (in the subsequent production of foliar leaves); the third in frequency was the cohesion of members of a cotyledonary whorl; the fourth was the bifurcation of the axis of the cotyledon; the fifth, fission or lobing of the cotyledon; and, last, stem abnormalities—bifurcation of the seedling axis, and hypocotylous supplementary shoots, being rare within my experience.

The specimens have all been taken from cultivation, and, further, my inquiry, as far as the seedlings are concerned, has been spread over a field limited to three nurseries and a suburban garden and to one season only, excepting one species—*Coprosma lucida*.

1 In "A Contribution to our Knowledge of Seedlings" (Avebury) will be found a wealth of information as to normal plants, and a comprehensive bibliography.

Facilities were afforded me by the Conservator of Forests, Mr. H. Mackay; the Director of the Melbourne Botanic Gardens, Mr. J. Cronin; and Messrs. Brunning and Son, to examine the seedling beds in the respective nurseries. The State Forests Nursery, established principally for the sowing and nursing of eucalypts, is at Broadford; the other plants were observed in my private garden at Kew. Nothing like an exhaustive search was made or attempted in the limited time available, and though many genera were noticed, the quest was made with the study of seedlings of *Eucalyptus* as the main object in view.

Polycotyly.—In some species there appears to be a tendency to polycotyly, the deviation from normal conditions ending there; in others this tendency seems to have strengthened into a habit without subsequent growth of the plant being affected, while in a third phase the impulse given is continued into successive foliar organs in their arrangement relative to the axis. In frames containing some thousands of *Pittosporum nigrescens*, I failed to find a single dicotylous plant, although 3-merous and 4-merous forms were common, and 5-merous seedlings were in the proportion of about 1-100.

The species of which I exhibited specimens with increased number of cotyledons are as follows:—

Cupressus macrocarpa -	3-, 4-, 5-, and 7-merous forms, frequent; 2-merous forms not seen
Cuprosma ludica[1] - -	3-merous, in proportion of about 6:100
Eucalyptus Muelleriana -	3-merous, rare.
,, *resinifera* -	3-merous, 1:500.
,, *radiata* - -	3-merous, about 1:100.
,, *Risdoni* - -	3-merous, about 1:100.
,, *cornuta* - -	3-merous, rare.
Dillwynia cinerascens -	3-merous, 1.22.
Ligustrum (chinensis ?) -	3-merous, 9:140.
Sterculia (sp.) - -	3-merous, 1:20.
Pittosporum tenuifolium -	3-, 4- and 5-merous.
,, *floribundum* -	3-merous 3:80.
,, *Buchanianum* -	Only two out of 17 in one lot were dicotylous, five were 3-merously whorled, nine 4-merously and one 5-merously.
,, *nigrescens* -	3-, 4- and 5-merous (see above).
,, *undulatum* -	Many 3-merous whorls seen.
Cytisus prolifcrus - -	3-merous, about 3:100.
Mandevillea (sp.) - -	3-merous, numerous.
Gleditschia triacanthos -	3-merous about 3:1000.
Callistemon lanceolatus -	A few, not counted.

1 Result of observation during 3 seasons of seedlings of the same tree.

Angophora intermedia -	Of five seedlings at Broadford, two were 3- and four were 4-merous. As the seed came from the native habitat in Croajingolong the abnormal growth could not be credited to repeated cultivation.
Magnolia grandiflora -	3-merous, 3:17.
Clematis (sp.) - -	3-merous, 1:4.
Schinus molle - -	3-merous, 8:2000.
Acacia stricta - -	3-merous, 1:30.
Cytisus alba - - -	Account not kept.
Thujopsis borealis - -	3-merous, 3:100.
Bursaria spinosa - -	3-merous, a small percentage.

With few exceptions the whorls were characterised by radial symmetry, and this, taken with other characters such as venation, points to the numerical increase originating in corresponding superfluity of leaf primordia in the young seed rather than to early fission of the growing cotyledon.

Polyphylly.—Occasionally the whorl of cotyledons was found to be accompanied by a similarly increased whorl of foliar leaves, and in a few instances increase was repeated at successive nodes. Amongst 40 normal Linaria plants several had four whorls, including that of the cotyledons. The undermentioned species yielded forms with increase of foliar leaves supervening on tricotyly.

Coprosma lucida.
Eucalyptus cladocalyx.
E. resinifera.
E. Risdoni.
Linaria (Sp.).
Ligustrum chinensis.

Bifurcation of Axis.—This occurrence, known to some nurserymen as "double-heading," has an economic value at times in that a shrub or tree ordinarily too tall for some situations produces two equal branches near the ground, each being stronger than a lateral branch.

1. Epicotylous forking of the stem was observed in *Cytisus proliferus*. This may have been caused by early arrest of the normal shoot and consequent production of what might be termed cotylaxillary shoots, referred to later in connection with *Eucalyptus cornuta*.

2. Supercotylous forking of the stem axis was seen in a specimen of *Tilia Americana*, the division being about three cm. above the level of the cotyledons.

Cohesion of Cotyledons.—It is assumed that the presence of a "midrib" in each half of an over-broad cotyledonary member,

together with appropriate venation and a thickened petiole, indicate connation of two leaves by their inner margins, or that the fusion has been due to the crowding of primordial papillae. Thus the following species, in which the forenamed conditions were evident, may be listed as having afforded specimens :—

Pittosporum tenuifolium.

P. floribundum.

Coprosma lucida.

Schinus molle.

Sterculia (hybrida?).

Raphanus (Sp.).—In the radish there occurred a form with trilobed seed leaves due to each leaf consisting of a fused pair.

I have not observed any but *lateral* cohesion of two members of polymerous whorls. Fusion of opposed members by their bases, thus giving a perfoliate appearance, may have existed among the many seedlings seen. This feature is less conspicuous, however and if present was unnoticed. The Sterculia had an asymmetric whorl composed of the two fused leaves and an aborted third.

Sterculia (hybrida?) : Amongst 24, one with bifid leaf.

Pittosporum tenuifolium ; One only with a bifid leaf.

P. Buchanianum : One leaf of a trimerous whorl of cotyledons slightly bifid.

Daucus Carota : One cotyledon bifid slightly. In another plant one leaf bifid and the other unequally trifid. (Guppy found 25 out of 135 seedlings of *Lepidium sativum* with tripartite cotyledons.)

Other Abnormalities.—The only instance seen where axillary growths occurred in a very young seedling was in the case of *Eucalyptus cornuta*, in which buds were present in both cotylar and foliar axils. The cotyledons were verticillate, and the foliar leaves normal.

Linaria (purpurea?) cultivated at Kew showed a tendency to produce supernumerary shoots of hypocotylous origin (about 5 per cent.). When the plants had produced less than a fourth of their mature foliage, or earlier, they were found with a shoot developing near the ground, or sometimes hypogeal, and producing 3-merous whorls of foliar leaves. (Masters records a similar occurrence in *L. vulgaris*, *Anagalis arvensis*, *Euphorbia peplus* and some umbelliferae.)

Malposition of cotyledons occurred in *Acacia stricta*, the pair, instead of retaining an opposite position, being forced round by the vigorously growing, humiphilous shoot until they were to one side

of the axis, and almost laterally connate. This was noticed in 7 of the 19 plants examined.

In the case of *Pittosporum tenuifolium*, the arrangement of the five cotyledons before expansion was noted. They were curled up within the seed, like straps rolled with flat surfaces in contact, but, as shown in the drawing, there was provision for radially symmetric growth after expansion; the outer leaves being slightly shorter than the inner, with petioles twisted obliquely in order to have the blades in mutual contact. The members, after artificial withdrawal from the seed coat, separated with a knife and immersed in water, soon assumed an approach to the radial form. This observation makes less tenable the fission theory of multiplication of linear cotyledonary leaves. (See Figs. 23 and 24 a, b.)

The many instances of seedling abnormalities given above, and a review of records by Avebury (Lubbock), Mueller, Masters, Guppy, Duchartre, Bailey, Schrenk, etc. (their observations affecting cultivated plants chiefly), leads one to think that there is ground for further interesting inquiry among the seedlings of native plants in their habitats. F. V. Mueller's[1] investigation, in 1882, of polycotyly in New Zealand species of the genus *Forsoonia*, resulted in the surprising record of there being amongst 23 species examined only four with dicotylous seedlings; and, he wrote: "It may be fairly assumed that in the genus as a whole the pluricotyledonary embryo by far preponderates." This fact adds interest to the data given for Pittosporum nigrescens mentioned above, and perhaps to observations on other species such as P. tennufolium and P. undulatum.

EXPLANATION OF PLATE.

Figs. 1 to 5 —Coprosma lucida.
,, 6 and 7 —Eucalyptus radiata.
,, 8, 9 and 10—E. Risdoni.
,, 11 and 12—Dillwynia cinerascens.
,, 13 and 14—Acacia stricta.
,, 15 to 18 —Pittosporum Buchanianum
,, 19 —P. tenuifolium.
,, 20 —P. Buchanianum.
,, 21 and 22—Daucus carota.
,, 23 and 24—Pittosporum tenuifolium.
,, 25 —Linaria (purpurea ?).
,, 26 —Eucalyptus cornuta.

Note.—All figures semi-diagrammatic.

1 N.Z. Jour. Sc. I., p. 115.